

CLAIMS

- 1 1. A router for use in routing packets over a network, the router supporting 2^n classes of
2 service and including:
- 3 A. a plurality of input ports for receiving packets over the network;
- 4 B. a plurality of output ports for transferring packets over the network;
- 5 C. a classifier for assigning packets received by the input ports to 2^{n+m} classes of
6 service and mapping the 2^{n+m} classes of service to the 2^n classes of service that are
7 supported by the router, the classifier assigning to the packet one of 2^m associated levels
8 of priority, wherein each level of priority is associated with a different probability of
9 packet loss;
- 10 D. means for retaining the packets based on probabilities of discard associated
11 with the 2^{n+m} classes of service; and
- 12 E. scheduling means for transferring the packets through each of the output ports
13 based on the 2^n classes of service.
- 1 2. The router of claim 1 further including a multiple storage location buffer for retaining
2 packets to be transferred through the output ports, the buffer linking the storage locations
3 that contain packets in class of service per output port queues and linking available
4 storage locations in a free queue.
- 1 3. The router of claim 2 wherein the means for retaining the packets further includes:
2 i. means for determining a new weighted average depth for the free queue, and
3 ii. means for determining a probability of discard for a given packet if the new
4 weighted average queue depth falls below a predetermined maximum threshold
5 associated with the class of service to which the packet is assigned.
- 1 4. The router of claim 3 wherein the discard means discards a given packet if the
2 associated new weighted average depth for the free queue falls below a minimum
3 threshold associated with the class of service to which the packet is assigned.

1 5. The router of claim 4 wherein the discard means calculates the probability of discard
2 as $P_d = c - (m * A_{NEW})$ where c is an intercept and m is a slope that is associated with a line
3 that plots average free queue depth versus probability of discard for the class of service to
4 which the packet is assigned, and A_{NEW} is the new weighted average depth of the free
5 queue.

1 6. The router of claim 5 wherein the discard means calculates the new weighted average
2 depth of the free queue as $A_{NEW} = A_{CURRENT} + w(I - A_{CURRENT})$ where w is a weighting
3 factor, I represents the instantaneous depth of the free queue and $A_{CURRENT}$ is the current
4 weighted average depth of the free queue.

1 7. The router of claim 6 wherein the scheduling means selects packets for transfer based
2 on weighting factors associated with the respective 2^n classes of service.

1 8. A router for use in routing packets over a network, the router supporting 2^n classes of
2 service and including:

- 3 A. a plurality of input ports for receiving packets over the network;
4 B. a plurality of output ports for transferring packets over the network;
5 C. a multiple storage location buffer for retaining packets to be transferred
6 through the output ports;
7 D. means for retaining the packets based on probabilities of discard associated
8 with 2^{n+m} classes of service; and
9 E. scheduling means for transferring the packets through each of the output ports
1 based on the 2^n classes of service that the router supports.
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1 9. The router of claim 8 further including a classifier for:
2 i. assigning packets received by the input ports to 2^{n+m} classes of service,

3 ii. associating the packets with the 2^n classes of service that are supported by the
4 router, and

5 iii. assigning to the packet one of 2^m associated levels of priority, wherein each
6 level of priority is associated with a different probability of packet loss.

1 10. The router of claim 9 wherein the means for retaining the packets further includes

2 i. means for determining a new weighted average queue depth for a free queue
3 that links available buffer storage locations, and

4 ii. means for determining a probability of discard for a given packet if the new
5 weighted average free queue depth falls below a predetermined maximum threshold
6 associated with the class of service to which the packet is assigned.

1 11. The router of claim 10 wherein the discard means calculates the probability of
2 discard as $P_d = c - (m * A_{NEW})$ where c is an intercept and m is a slope that are associated
3 with a line that plots average free queue depth versus probability of discard for the class
4 of service to which the packet is assigned, and A_{NEW} is the new weighted average depth
5 of the free queue.

1 12. The router of claim 11 wherein the discard means calculates the new depth of the free
2 queue as $A_{NEW} = A_{CURRENT} + w(I - A_{CURRENT})$ where w is a weighting factor, I represents
3 the instantaneous depth of the free queue and $A_{CURRENT}$ is the current weighted average
4 depth of the free queue.

1 13. The router of claim 12 wherein the discard means discards a given packet if the new
2 weighted average free queue depth falls below a minimum threshold associated with the
3 class of service to which the packet is assigned.

1 14. The router of claim 12 wherein the discard means retains a given packet if the new
2 weighted average free queue depth is above a maximum threshold associated with the
3 class of service to which the packet is assigned.

1 15. The router of claim 8 wherein the scheduling means selects packets for transfer
2 through each output port based on weighting factors associated with the respective 2^n
3 classes of service.

1 16. The router of claim 15 wherein the buffer links retained packets in class of service
2 per output port queues and the scheduling means selects packets from the class of service
3 per output port queues.

1 17. A method of routing packets through a router that supports 2^n classes of service, the
2 method including the steps of:

3 A. receiving packets through one or more input ports;

4 B. assigning packets received by the input ports to 2^{n+m} classes of service and
5 mapping the 2^{n+m} classes of service to the 2^n classes of service that are supported by the
6 router, the classifier assigning to the packet one of 2^m associated levels of priority,
7 wherein each level of priority is associated with a different probability of packet loss;

8 C. retaining the packets based on probabilities of discard associated with the 2^{n+m}
9 classes of service; and

10 D. transferring the packets through one or more output ports based on the 2^n
11 classes of service.

1 18. The method of routing packets of claim 17 further including in the step of retaining
2 the packets the steps of :

3 i. retaining the packets in a multiple storage location buffer and linking available
4 storage locations to a free queue,

1 ii. determining a new weighted average depth for the free queue, and

2 iii. determining a probability of discard for a given packet if the new weighted
3 average queue depth falls below a predetermined maximum threshold associated with the
4 class of service to which the packet is assigned.

1 19. The method of routing packets of claim 18 including in the step of retaining the
2 packets the further step of discarding a given packet if the new weighted average depth
3 for the free queue falls below a minimum threshold associated with the class of service to
4 which the packet is assigned.

1 20. The method of routing packets of claim 19 wherein the step of retaining the packets
2 includes calculating the probability of discard as $P_d = c - (m * A_{NEW})$ where c is an intercept
3 and m is a slope associated with a line that plots weighted average free queue depth
4 versus probability of discard for the class of service to which the packet is assigned, and
5 A_{NEW} is the new weighted average depth of the free queue.

1 21. The method of routing packets of claim 20 wherein the step of retaining the packets
2 includes calculating the new weighted average depth of the free queue as $A_{NEW} =$
3 $A_{CURRENT} + w (I - A_{CURRENT})$ where w is a weighting factor I represents the instantaneous
4 depth of the free queue and $A_{CURRENT}$ is the current weighted average queue depth.

1 22. The method of claim 21 wherein the discard means retains a given packet of the new
2 weighted average free queue depth is above a maximum threshold associated with the
3 class of service to which the packet is assigned.

1 23. The method of routing packets of claim 17 wherein the step of transferring packets
2 through the more or more output port transfers the packets based on weighting factors
3 associated with the respective 2^n classes of service.

1 24. A method of routing packets through a router that supports 2^n classes of service, the
2 method including:

3 A. receiving packets through one or more input ports and assigning the packets to
4 2^{n+m} classes of service;

5 B. retaining packets based on probabilities of discard associated with the 2^{n+m}
6 classes of service in a multiple storage location buffer that links available storage
7 locations to a free queue; and

1 C. transferring the packets through one or more output ports based on the 2^n
2 classes of service.

1 25. The method of routing of claim 24 further including the steps:

2 i. associating the packets that are assigned to the 2^{n+m} classes of service with the
3 2^n classes of service that are supported by the router, and

4 ii. assigning to the respective packets one of 2^m associated levels of priority,
5 wherein each level of priority is associated with a different probability of packet loss.

1 26. The method of routing packets of claim 25 wherein the step of retaining the packets
2 includes:

3 a. determining a new weighted average depth for the free queue, and

4 b. determining a probability of discard for a given packet if the new weighted
5 average free queue depth falls below a predetermined maximum threshold associated with
6 the class of service to which the packet is assigned.

1 27. The method of routing packets of claim 26 wherein the step of retaining packets
2 further includes calculating the probability of discard as $P_d = c - (m * A_{NEW})$ where c is an
3 intercept and m is a slope that are associated with a line that plots average free queue
4 depth versus probability of discard for the class of service to which the packet is assigned,
5 and A_{NEW} is the new weighted average depth of the free queue.

1 28. The method of routing packets of claim 27 wherein the step of retaining packets
2 further includes calculating the new weighted average depth of the free queue as $A_{NEW} =$
3 $A_{CURRENT} + w (I - A_{CURRENT})$ where w is a weighting factor, I represents the instantaneous
4 depth of the free queue and $A_{CURRENT}$ is the current weighted average queue depth.

1 29. The method of routing packets of claim 26 wherein the step of retaining packets
2 further includes discarding a given packet if the new weighted average free queue depth
3 falls below a minimum threshold associated with the class of service to which the packet
4 is assigned.

1 29. The method of routing packets of claim 26 wherein the step of retaining packets
2 further includes retaining a given packet if the new weighted average free queue depth is
3 above the maximum threshold associated with the class of service to which the packet is
4 assigned.

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